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GRINDING SYSTEM WITH COOLANT SUBSYSTEM

TECHNICAL FIELD

[0001] This invention relates generally to the machining field, and more specifically to an improved grinding system with a coolant subsystem.

BACKGROUND OF THE INVENTION

[0002] The machining of an inner race for a constant-velocity joint of an automobile is a complex process. In a related application, U.S. Serial No. _____________ filed ______________ and owned by the same assignee (Attorney Docket No. 10541-543/V201-0316), the inventor has described the method of machining a part using a single clamp on a chuck and an OD-type grinding tool on the part. One of the difficulties of using an OD-type grinding tool on an inner race for a constant-velocity joint is adequately transferring the excess heat from the grinding system. In conventional systems, the access heat is typically transferred by a coolant material sprayed at a fixed point between the grinding surface of the grinding tool and the outer surface of the part. In the process described in the related application, however, the grinding tool moves through an actuate path and the use of a conventional fixed nozzle to supply the coolant material would result in a less-than-desired transfer of the excess heat. For this reason, there is a need in the grinding field for a new and improved coolant subsystem.

BRIEF DESCRIPTION OF THE DRAWINGS

[0003] FIGURE 1 is a top view of a finished product machined with the preferred embodiment of the invention;

[0004] FIGURE 2 is a perspective view of the finished product of FIGURE 1;

[0005] FIGURE 3 is a cross-sectional view of the grinding system of the preferred embodiment of the invention;

[0006] FIGURE 4 is a side view of the grinding system of FIGURE 3, shown with the nozzle in a first position; and

[0007] FIGURE 5 is a partial side view of the grinding system of FIGURE 3, shown with the nozzle in a second position.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT OF THE INVENTION

[0008] The following description of the preferred embodiment of the invention is not intended to limit the invention to this preferred embodiment, but rather to enable any person skilled in the grinding art to use this invention.

[0009] As shown in the FIGURES, the preferred embodiment of the invention includes a grinding tool 10 having a grinding surface 12 adapted to grind a part 14, a nozzle 16 adapted to supply a coolant material 18, and an arm 20 coupled to the nozzle 16 and to the grinding tool 10 and adapted to allow placement of the nozzle 16 in multiple positions. Each of the positions of the nozzle 16 is preferably substantially tangent to the grinding surface 12 of the grinding tool 10, which optimizes the transfer of excess heat from the grinding tool 10 and the part 14. The preferred embodiment of the invention has been specifically designed to machine an

inner race for a constant-velocity joint having six ground ball tracks. The preferred embodiment, however, may be used, with or without additional machining devices, to machine any suitable part for any suitable environment having at least one ground surface.

[0010] As shown in FIGURES 1 and 2, the ball track 22 of the part preferably has a complex curvature including a concave curve along a plane defined by the X and Y axis and a convex curve along the Z axis. Although the concave curve is preferably machined by a simple rotation of the profile of the grinding tool 10, the convex curve is accomplished by an actuate movement of the part relative the grinding tool 10.

[0011] As shown in FIGURE 3, the grinding tool 10 of the preferred embodiment is an OD-type grinding tool 10, which spins along an axis generally perpendicular to the rotational axis of the part. The grinding tool of a conventional system, in contrast, is an ID-type grinding tool, which generally spins along an axis parallel with the rotational axis of a part at a much higher speed than the OD-type grinding tool 10. In all other aspects, the OD-type grinding tool 10 is preferably a conventional device. The grinding tool 10 is preferably securely connected to a spindle 24. The spindle 24 functions to translate a rotational output from a first motor 26 to a rotational movement of the grinding tool 10. Both the spindle 24 and the first motor 26 are conventional devices, but may alternatively be any suitable device that functions to impart a rotation and torque on the grinding tool 10.

[0012] As shown in FIGURES 3 and 4, the nozzle 16 of the preferred embodiment functions to supply the coolant material 18. The coolant material 18, which functions to transfer the excess heat from the grinding tool 10 and the part 14,

is preferably a conventional material, but may alternatively be any suitable material that functions to transfer excess heat. Although not necessary, the nozzle 16 is preferably shaped and sized to supply the coolant material 18 at the substantially same velocity as the grinding surface 12 of the grinding tool 10. This is preferably accomplished by using a predetermined velocity for the grinding surface 12 and adjusting the pressure of the coolant material 18 and the size and shape of the nozzle 16.

[0013] The performance of the coolant material 18 is optimized when sprayed from the nozzle 16 between the grinding tool 10 and the part 14 along a substantially tangent line to the grinding surface 12 of the grinding tool 10. Because the part is moved along an actuate path relative the grinding tool 10, the arm 20 of the preferred embodiment functions to allow placement of the nozzle 16 in multiple positions. As shown in FIGURES 4 and 5, the positions of the nozzle 16 are substantially tangent to the grinding surface 12 of the grinding tool 10, while armed to supply coolant material 18 between the grinding tool 10 and the part 14. In the preferred embodiment, a bearing collar 28, located around the spindle 24 of the grinding tool 10, functions to couple the spindle 24 and the arm 20 and to communicate the coolant material 18 from a reservoir (not shown) to the nozzle 16. This arrangement allows the arm 20 to pivot about the same rotational axis as the grinding tool 10. In alternative embodiments, other devices may be used to connect the arm 20 with the grinding system and to allow communication of the coolant material 18 to the nozzle 16. Just as the grinding tool 10 preferably moves along an actuate path to grind the ball track into the part 14, the arm 20 is preferably adapted to allow placement of the nozzle 16 along an arcuate path. The arm 20 is preferably

moved through a connection with a second motor 30 and a belt 32, which functions to translate rotation of the second motor 30 into movement of the arm 20. Both the belt 32 and the second motor 30 are conventional devices, but may alternatively be any suitable devices to allow placement of the nozzle 16 in multiple positions.

[0014] The grinding system of the preferred embodiment also includes a controller 34, which functions to control the movement of the nozzle 16. The controller 34 is preferably a computer numeric control ("CNC") device, but may alternatively be any suitable device that allows precise tracking of multiple devices within a machining system. The controller 34 is preferably coupled to a device (not shown) that moves the part relative the grinding tool 10 and, in this manner, the controller 34 is able to control the movement of the nozzle 16 based upon the location of the part relative the grinding tool 10. Other suitable devices or systems, of course, may alternatively be used to control the movement of the nozzle 16.

[0015] As any person skilled in the art of grinding systems will recognize from the previous description and from the figures and claims, modifications and changes can be made to the preferred embodiment of the invention without departing from the scope of this invention defined in the following claims.